

**Leishman, Michelle**



michelle.leishman@mq.edu.au Department of Biological Sciences, Macquarie University, NSW 2109

### **Predicting invasiveness from plant traits: the role of disturbance type.**

One of the major threats to global biodiversity is invasion by exotic plant species. Many studies have attempted to relate invasiveness to plant traits, with limited success. It has become increasingly apparent that the interaction between the invader and the target community is critical. I present data on a range of traits of native and invasive species from sites subject to different disturbance types: nutrient enrichment, urban creeks, physical disturbance and grazing. Specific leaf area (SLA) of invasive exotic species was consistently higher than native species, regardless of disturbance type. In sites subject to physical disturbance or grazing, invasive species were more likely to be herbs and grasses, while in sites subject to nutrient-enrichment, exotic species were more likely to be climbers. In physically disturbed sites, invasive species had smaller seed mass than natives. Differences in dispersal mode between natives and invasives depended on disturbance type. Thus there are relationships between invasiveness and plant traits, but these are, with the exception of SLA, disturbance-specific.

**Lenz, Tanja and José M. Facelli**



tanja.lenz@adelaide.edu.au Environmental Biology - School of Earth and Environmental Sciences, The University of Adelaide, Adelaide SA 5005

### **How not to recruit perennial grasses: the role of abiotic and biotic factors in the recruitment of invasive annuals and native perennial grasses in a South Australian grassland.**

We investigated what factors lead to invasion of exotic annuals or re-colonisation of native perennial grasses in the South Australian mid-north grasslands. We manipulated 160 experimental plots by clipping, irrigation and seed addition and assessed exotic annual recruitment in an area dominated by perennial grasses and perennial grass recruitment in an area dominated by exotic annuals. Treatment effects differed with season for exotic annuals: their biomass increased with irrigation in autumn and seed addition in winter. However, in both periods other factors, probably soil properties, also had a strong effect. We detected no perennial grass seedlings in the plots over one year, possible due to unsuitable environmental conditions or persistent high competition levels. Under controlled conditions the presence of the invasive annual *Avena barbata* had a strong negative effect on the native perennial *Austrodanthonia caespitosa* recruitment at any moisture and nutrient availability. *Avena* also germinated faster and more frequently than *Austrodanthonia*, especially at low soil moisture. During an imposed drought, *Austrodanthonia* seedlings survived longer in the absence of *Avena*. The results suggest that annual exotics are highly responsive to resources and can quickly invade areas, while the re-colonisation of invaded areas by native grasses requires a complex (and less likely) rainfall regime.

**Leonard, Steven**



School of Geography and Environmental Studies, University of Tasmania Hobart, Private Bag 78, GPO, Hobart, Tasmania, Australia 7001.

### **The effects of grazing management on native grassland and grassy woodland in the Northern Midlands, Tasmania.**

Most remnants of lowland grassland and grassy woodland in Tasmania are used for grazing sheep. Some native pastures have high conservation value, indicating that grazing and biodiversity conservation are not necessarily conflicting management goals. However few data exist on the management practices most conducive to maintaining conservation values. This study examined native grassland and grassy woodland subject to seven sheep grazing regimes in the Northern Midlands of Tasmania, and sought to identify environmental and management effects on vegetation structure and composition. Vegetation type appeared to be the most influential environmental factor. Attributes of the vegetation and herbivore scat counts, suggested that grazing disturbance was more intense in grassland than in woodland. There were floristic differences between sites subject to different management regimes. Species not commonly observed in grassy vegetation were most abundant in spring-spelled sites, while sites subject to more intense regimes contained a species assemblage typical of disturbed areas. Exotic invasion was greatest at sites that were not spelled and/or had higher stocking rates. Low stocking rates and/or spelling thus appear conducive to the maintenance of condition in lowland grassy vegetation. The application of a range of management regimes has helped maintain plant species diversity on a landscape scale.

**Lewis, Tom<sup>1</sup>, Nick Reid<sup>1</sup>, Peter Clarke<sup>2</sup> and R.D.B (Wal) Whalley<sup>2</sup>**



tlewis3@metz.une.edu.au 1. Ecosystem Management, University of New England, Armidale, NSW 2351. 2. Department of Botany, University of New England, Armidale, NSW, 2351

### **Short-term impacts on plant diversity after burning native grassland at Kirramingly Nature Reserve, Moree Plains, NSW.**

Kirramingly Nature Reserve contains the only reserved example of a Mitchell grass – Queensland Bluegrass community in NSW, and is an important remnant on the Moree Plains where the native vegetation has been largely modified for agriculture. This research aims to determine the impact of season and frequency of fire on vegetation community composition and to investigate the effect of native herbivore grazing after fire on species composition. Twelve 4-ha plots in a randomised block design were burnt in 2002, six in autumn and six in spring. Vegetation composition was surveyed prior to the fires and is being monitored at 6-month intervals. Preliminary results indicate that these native grasslands are naturally resilient to fire in either season. In autumn 2003 (1 year after the autumn burn and 6 months after the spring burn), species richness was not significantly different from the control plots, and species composition was similar at all sites. However, rainfall after fire plays an important role in time taken to recover. Excluding kangaroos from burnt areas has had no impact on species richness or composition to date. Further monitoring of the trial plots (until autumn 2004) and analysis of the results will be undertaken. The information gained from this research will be useful to the NSW National Parks and Wildlife Service for managing these grasslands for conservation.

**J. Li<sup>1</sup>, J. A. Duggin<sup>1</sup>, C. D. Grant<sup>1,2</sup>, and W. A. Loneragan<sup>3</sup>**



addresses?

### **Resilience of Native Species or Non-Native Species? A Case Study of Grassland Responses to Multiple Disturbances on The New England Tablelands, NSW, Australia**

Plant communities have been subjected to accelerated pressure and impacts from disturbances resulting from human activities. However, ecological understanding of their specific and interactive effects remains weak. This study experimentally examined the responses of temperate grassland communities to disturbances, using a multi-factorial experiment involving grazing (absent and present); fire (absent and present); soil cultivation (none, 5 and 20 cm); and amendment (none, fertiliser, and fertiliser plus clover seeds) on the New England Tablelands, NSW, Australia. Generalized additive models, generalized linear mixed models and multivariate analyses were applied to the data collected over a 24-month period following disturbance.

Native perennial grasses and a non-native species *Hypochaeris radicata* initially dominated the grasslands, but after the experimental disturbances *Hypochaeris radicata* and other non-native species dominated. Compositional changes from the initial states were greatest in the first spring (7 months after treatment), and then tended to return towards the prior state, indicating a high resilience. Soil cultivation resulted in the greatest change in composition, followed by soil amendment, then fire and grazing exclusion the least. However, the recovery process and rate varied with individual treatment combination. The compositional changes resulted from a reduction in dominant perennial grasses and an increase in non-native species, while strong resilience was mainly due to the rapid recovery of *Hypochaeris radicata* following the treatments. The high resilience of these grasslands in relation to disturbance indicates that small-scale disturbance such as deep soil cultivation and its interaction with amendment, grazing, and fire have not caused vegetation to cross an ecological threshold, implying an important role for scale in response to disturbance. Application of such results to any larger scale, therefore, should be made with caution.

**Lindenmayer, David and Joern Fischer**



joern@cres.anu.edu.au Centre for Resource and Environmental Studies, The Australian National University, Canberra ACT 0200

### **Investigating threshold responses for vertebrates: case studies from the Tumut Fragmentation “Natural Experiment”**

The search for threshold responses for biota has become a major focus of recent biodiversity-related research in landscapes modified by humans. Much of the early work on threshold responses for biodiversity has been theoretical and derived from hypothetical landscape cover and landscape change models. In this study, we examine the response of mammal, reptile and bird assemblages to patterns of native vegetation cover in the Tumut region of southern New South Wales (south-eastern Australia). The study area is characterized by large areas of native eucalypt forest, extensive stands of Radiata Pine plantation, and areas where the proportion of both types of cover varies. Such variation in cover provides an ideal environment for rigorous empirical tests of threshold response relationships.

Statistical modelling based on extensive field datasets provided no firm evidence for the presence of significant step-function or threshold relationships between the amount of native eucalypt vegetation cover and the diversity of mammal, reptile or bird assemblages– including at the 30% cover levels often suggested to be the “key” threshold cover levels by some workers. Rather there was strong evidence for gradients of responses to vegetation cover patterns. A complex array of factors probably account for these results, including large differences in the way different species (in the same vertebrate group) respond to the same landscape cover patterns. Indeed, some of our analyses suggest that a number of species were more likely to occur in more (rather than less) fragmented landscapes. There also were critical responses to other gradients that were not related to vegetation cover or fragmentation.

The lack of empirical support for threshold relationships does not mean that such relationships do not occur elsewhere or for certain species – further testing in some of our other large-scale studies will be undertaken in the near future to assess the generality of the results presented here. Our results also do not negate the value of the threshold concept for other reasons. These include political and social ones like setting targets to maintain given levels of native vegetation cover in agricultural and wood production landscapes.

**Lindsay, Elizabeth and Kris French**



elindsay@uow.edu.au Department of Biological Sciences, University of Wollongong, Northfields Ave, Wollongong, NSW, 2522

### **Bitou Bush Invasion Changes Coastal Ecosystem Processes**

The environmental weed *Chrysanthemoides monilifera* ssp. *rotundata* (bitou bush) now covers more than 70000ha of the NSW coastline. Despite extensive infestations, the impacts of this weed are largely unknown. Dense infestations were found to alter litter decomposition rates, nutrient cycling, and soil properties through changes in litter quality and quantity. The succulent bitou leaves decomposed faster than a native leaf mix, and all leaves decayed faster within bitou bush infestations, most likely due to the changed microclimate. The dense canopy formed by bitou bush decreased light penetration, and was accompanied by an increase in soil moisture and a decrease in soil surface temperature. The litterfall rate was several times lower in the bitou habitats, this combined with the fast decomposition rate lead to there being significantly less litter on the forest floor. There was an increase in total soil nitrogen and ammonia in the weedy habitat. The consequences of these changes in nutrient cycling and litter decay will be discussed along with the movement of the nutrients from decomposing litter. These results may aid in predicting the impact of infestations on natural ecosystems and assist in weed management.

**Llorens, Tanya**



tml06@uow.edu.au Institute for Conservation Biology, University of Wollongong, Wollongong, NSW 2522

### **Can the seed bank prevent genetic changes in *Grevillea caleyi* populations?**

Long-lived seed banks potentially slow the rate of genetic changes within a plant population. In this study, I investigated whether the soil-stored seed bank of the endangered, fire-sensitive shrub, *Grevillea caleyi*, may buffer some of the genetic changes associated with population fragmentation. This species has had recent severe reductions in population size, so that many populations are at risk of demographic extinction and potentially deleterious genetic changes. *Grevillea caleyi* seeds may persist in the soil for many years and over at least two generations. Using seven microsatellite loci, I genotyped post-fire seedlings and pre-fire adults from two small populations (< 20 pre-fire adults). In both populations, post-fire seedlings contained greater genetic diversity than pre-fire adults, including several unique alleles, which indicates that the seed bank is acting as a reservoir of additional genetic diversity. However, levels of inbreeding and fine-scale genetic structure were significantly higher among the seedlings than adults, suggesting that genetic changes are occurring in these populations despite the influence of the seed bank. In addition, only a small proportion of the pre-fire adults appeared to have contributed to the seed bank, which, over time, should result in a loss of genetic diversity.

**Lloyd, Samantha<sup>1</sup>, David Ayre<sup>1</sup> and Rob Whelan<sup>2</sup>**



sm195@uow.edu.au 1. Department of Biological Sciences, University of Wollongong, North Wollongong, NSW, 2522. 2. Faculty of Science, University of Wollongong, North Wollongong, NSW, 2522.

### **Measuring Interplant Variation in *Grevillea macleayana* (Proteaceae) Nectar Production**

Quantifying interplant variation in nectar production is necessary in understanding the importance of nectar in plant reproductive ecology and the relationships between plants, pollinators and fitness. However, achieving this in *Grevillea macleayana* is impeded by long periods of inflorescence nectar production (~9 days) and frequent rain during sampling. The aims of this study were to (1) identify interplant variation in *G. macleayana* nectar production and (2) devise a method of measuring nectar production on a sub-set of days that accurately represents total inflorescence nectar production. I bagged 80 inflorescences on ten *G. macleayana* plants, at two sites in Jervis Bay (south-eastern NSW). Nectar volume was measured (50µl micro-capillary tubes) and sugar concentration estimated (hand-held refractometer) daily, until all flowers/inflorescence ceased nectar production. Inflorescence nectar produced over two days (with >25% of flowers open/inflorescence on first day measurements) were tested against total inflorescence nectar production, revealing a significant positive relationship ( $P=0.00$ ;  $R^2=0.77$ ). Total inflorescence nectar production varied significantly among plants at both sites ( $P<0.005$ ). Therefore, accurate measurements of *G. macleayana* nectar production can be made over a sub-set of days, reducing the likelihood of rain and allowing more time for further field experiments (eg. pollinator observations) within the flowering period.

**Logan, Vicki and Bob Pressey**



vicki.logan@npws.nsw.gov.au New South Wales National Parks and Wildlife Service, PO Box 402 Armidale NSW 2350

### **Testing the effectiveness of biodiversity surrogates in conservation planning - limitations of minimum set comparisons**

As databases for study areas improve, there is an emerging literature on testing biodiversity surrogates for conservation planning. A growing array of methods is being proposed and applied. One method popular with researchers is the comparison of results from minimum set algorithms (minsets). This involves selecting a notional set of conservation areas for one taxon (the surrogate) and comparing it to the set selected for another taxon (the target). Using data matrices (areas X biodiversity features) from western and north-eastern New South Wales, we show that measures of minset overlap between surrogate and target taxa are disproportionately sensitive to small differences in the distribution of features. Analysing sets of paired matrices that differed only very slightly in the distribution of features, we found that measures of difference between minsets (the commonly used Jaccard dissimilarity index) ranged up to 0.75 out of a possible maximum of 1.0, depending on endemism of features, minset selection rules, locations of differences between matrices, and conservation targets. Thus results of comparisons between surrogates and targets are sensitive to small differences in data structure and lack robustness. This result combined with the potential flexibility of minset results leads us to caution against using minset comparisons as a method of testing surrogates for conservation planning.

**Lomov, Boris<sup>1</sup>, Dieter Hochuli<sup>1</sup> and David Keith<sup>2</sup>**



blomov@bio.usyd.edu.au 1. Building A08, The University of Sydney, NSW 2006. 2. NSW National Parks & Wildlife Service, Hurstville, NSW 2220

### **Reconstructing Cumberland Plain Woodland community: Effects of pasture revegetation on seed removal by ants**

Cumberland Plain Woodland community of western Sydney has been extensively cleared for agricultural and residential use. Although, concern over the magnitude of these losses has triggered many restoration projects, the effectiveness of various techniques used to restore biodiversity and associated ecological functions remains largely unassessed. Abundance and diversity of ant species and the rates of seed removal by ants in pasture, revegetated areas (5-10 years old) and woodland remnants were compared using a nested design. Observations were conducted to identify the ant species responsible for seed removal. The ant species richness in forest remnants and revegetated areas was significantly higher than in pasture, with most ant species being significantly more abundant at forest remnants and revegetated stands than in pasture. The rates of seed removal by ants at revegetated sites were similar to those in forest remnants while the rates at pasture sites were significantly lower. Although restoration of grassy woodlands may take decades, our data suggests that recovery of certain ecological processes may take place at the early stages of restoration. Measurements of ecosystem structure used in conjunction with measurements of ecosystem function could serve as useful indicators of ecosystem recovery in evaluating restoration success.

**Lowor, Samuel, Alice Del Socorro and Peter Gregg**



slowor@metz.une.edu.au School of Rural Science and Agriculture, University of New England, Armidale, NSW 2351

**Pheromones of *Earias huegeliana* (Lepidoptera: Noctuidae) and *Crocidosoma plebejana* (Lepidoptera: Tortricidae)**

*Earias huegeliana* (rough bollworm) and *Crocidosoma plebejana* (cotton tipworm) are occasional pests of cotton whose presence is difficult to determine before damage occurs. Identification of the pheromones of these pests might provide the capacity to monitor and forecast outbreaks of these pests. The major components of the sex attractant pheromones of these species have been identified by GC-MS analysis of the contents of the pheromone glands and the effluent air surrounding calling females. The results are compared with those for closely related species from other countries. Synthetic lures which attract male moths have been prepared and tested in the field.

**Lunt, Ian and Nigel Jones**



ilunt@csu.edu.au The Johnstone Centre, Charles Sturt University, PO Box 789, Albury NSW 2640

**Effects of European colonisation on indigenous ecosystems: stand structure of pre- and post-settlement *Callitris - Eucalyptus* woodlands**

Changes to grazing and burning regimes following European settlement have led to altered stand structures in many natural systems. *Callitris glaucophylla* is known to have increased markedly across large areas of eastern Australia, but minimal information on pre-settlement stands structures is available. This project compared pre- and post-settlement stand structures in *Callitris - Eucalyptus* woodlands in central NSW across a range of spatial scales. Pre-settlement stands were assessed using surviving stumps, stags and trees in relatively undisturbed remnants. Hypotheses about pre-settlement spatial patterns were erected based on relative fire sensitivities of the two genera, and assumed higher fire frequencies before settlement. Preliminary results show that tree densities, genus ratios and size structures were highly variable at 1 ha scales. However, in most cases, *Callitris* density was considerably lower and eucalypt basal area was considerably greater than in current stands. Despite a number of methodological constraints, these results provide the first quantitative description of regional variations in pre-settlement stand structures.

**Lynch, Kath**



k.lynch@cmlr.uq.edu.au Centre for Mined Land Rehabilitation, Hartley Teakle Building, University of Queensland, St Lucia 4072

**Soil and plant water relations and native tree water use on soil capped bauxite residue, Gove, Northern Territory**

Developing revegetation targets for severely disturbed sites is often difficult due to a limited understanding of altered site conditions and how they may influence vegetation. In Gove, in the Northern Territory, research is being undertaken by the mining company Alcan Gove, in conjunction with the Centre for Mined Land Rehabilitation at the University of Queensland, to develop revegetation targets for previously rehabilitated soil capped bauxite residue areas based on altered site conditions. One aspect of this research is investigating how the reduced plant available soil moisture (PAM) of the rehabilitated sites may influence long-term sustainability of revegetated areas.

Seasonal measurements of PAM and plant water status are being monitored for a range of rehabilitated sites. Knowledge of soil and plant water relations over different seasons will enable a good estimation on the amount of water available to plants at different times of the year and how this affects vegetation dynamics. This information in conjunction with seasonal estimates of tree and plot water use will be used to develop revegetation targets based on both the seasonal amount of water available to plants in the rehabilitated sites and the water requirements of vegetation.

**McCallum, Hamish<sup>1</sup>, Gordon Grigg<sup>1</sup>, Andrew Taylor<sup>2</sup> and Graeme Watson<sup>3</sup>**



hmccallum@zen.uq.edu.au 1. Department of Zoology and Entomology, the University of Queensland Brisbane, Qld 4072.  
2. Department of Computer Science, University of New South Wales, Kensington, NSW. 3. Department of Zoology,  
Melbourne University, Parkville Victoria

**The impact of cane toads on native frogs along the Roper River, NT.**

Most of information about the impact of cane toads on native fauna remains anecdotal. We investigated the impact of toads on native frogs in the Northern Territory using a novel automated censusing technique. Machine learning technology identified frogs by their calls and then logged the information to flash card. We installed 10 recording stations in pairs along 100 kilometres of the Roper River. Here, we report results from the first five wet seasons, commencing in 1997-98. The sites were progressively overrun by toads, the first pair in the first wet season, with the last pair being overrun by early 2000. The number of frog species recorded calling decreased markedly over the five years at every site. There have been significant and substantial declines in the number of days of records for at least 7 of the 21 monitored species, with possible increases in 2. Whilst these data suggest that that toads may well have a detrimental effect on the frogs, at this stage we cannot unequivocally attribute the declines we have observed to the impact of toads.

**McDonald, Bill**



bill.mcdonald@epa.qld.gov.au Queensland Herbarium, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Qld 4066

**Distribution and Status of the Vine Thickets of the Brigalow Belt Bioregion**

Vine thicket communities, often known colloquially as "softwood scrub" or "bottle-tree scrub" (from the characteristic emergent *Brachychiton* spp.), extend through much of the Brigalow Belt Biogeographic Region of Queensland and northern New South Wales. During the 1960s and 1970s, large areas of vine thicket were cleared by pulling and burning, particularly in Central Queensland. Fifteen regional ecosystems dominated by vine thicket vegetation have been identified within the Brigalow Belt bioregion (Sattler & Williams 1999), and their pre-clearing and remnant extent mapped at 1: 100 000 scale by Queensland Herbarium botanists. Of an estimated original area of 1068000 ha, less than one-quarter (256000 ha) remained in 1999 (Accad, Neldner, Wilson & Niehus 2001). Ten of these ecosystems are included in the Semi-evergreen Vine Thicket ecological community listed nationally under the Environmental Protection and Biodiversity Conservation Act 1999. 46000 ha of vine thicket (18%) are held in conservation reserves, with a further 14000 ha in forest reserves. This amounts to less than 6% of the original extent of these communities. Many vine thicket remnants are small and most are threatened by the effects of recurrent fires and invasion by alien pasture grass species, as well as increasing pressure from grazing animals, both domestic and native.

**MacDonald, Michael**



michael.macdonald@forestrytas.com.au Forestry Tasmania, 79 Melville St, Hobart, Tas 7000

**Avifauna of retained vegetation corridors: a pre- and post-logging comparison**

Birds were surveyed before logging and ten years after logging in dry sclerophyll forest in Tasmania at a site where wildlife habitat strips (WHS) of 100 m width and streamside reserves (SR) of 40 m width had been established. Similar surveys were done in nearby extensive forest. There was a trend to lower species richness and abundance in WHS and SR that was not replicated in the control sites. Several species were significantly less abundant in WHS and/or SR although responses varied between vegetation types. However, some species sensitive to logging persisted in retained vegetation corridors, and there was no marked invasion of species characteristic of forest edges and disturbed habitats. Retained vegetation corridors maintain a slightly depauperate version of the avifauna of control areas. Differences might be expected to lessen as the surrounding native regrowth matures. Consideration should be given to the spatial configuration of WHS and SR in production forest landscapes, as wider corridors may be less susceptible to disturbance and inclusion of upper slope habitat in wider riparian corridors may provide a better conservation outcome than 100 m WHS located entirely on ridges or upper slopes.

**MacFarlane, Geoff**



geoff.macfarlane@newcastle.edu.au School of Environmental and Life Sciences, University of Newcastle, University Drive, Callaghan, NSW 2308

### **Mangroves as biological indicators of heavy metal contamination in estuarine systems**

The grey mangrove, *Avicennia marina* (Forsk.) Vierh, possesses a relatively high tolerance to heavy metals and thus may be employed as a biological indicator of heavy metal contamination in estuarine systems. Through both laboratory and field based studies, the metals copper (Cu), lead (Pb) and zinc (Zn) were accumulated in root tissue to levels equal to, or higher than, surrounding sediment levels. Strong linear relationships exist for all metals in sediments with metals in root tissue. Accumulation of Cu in leaf tissue followed a linear relationship at lower sediment concentrations, with an exclusion or saturation mechanism at higher sediment concentrations. Lead shows little mobility to leaf tissue, whereas Zn shows restricted accumulation in leaf tissue, which correlates with sediment concentrations. Restriction of Cu and Pb to the shoot is due to exclusion mechanisms at the root endodermis. Laboratory studies have shown that *A. marina* experiences dose-dependant stress responses to all metals in leaf tissue, evidenced by increases in peroxidase activity and decreases in photosynthetic pigment contents. From field-based studies, peroxidase activity may be an appropriate biomarker for Zn or total metal accumulation in leaf tissue, and the chlorophyll a/b ratio a suitable biomarker of Zn accumulation.

**McGrath, Warrick and Chris Chilcott**



Warrick.McGrath@nrm.qld.gov.au Department of Natural Resources and Mines, QCCA Building, 80 Meiers Road, Indooroopilly, Qld 4068

### **Quantifying the production and biodiversity values of trees in grazing systems in southern Queensland**

A balanced view of the role trees play in grazing systems is required to improve landscape level management and planning. We are currently researching the ecosystem function of tree strips in grazed paddocks in south-west Queensland. Measured benefits to production include improved pasture quality; regulation of microclimate; mitigation of salinity risk, retention of soil carbon and recycling of nutrients. These balance competition between trees and grasses for water and nutrients. The work presented in this paper summarises the initial findings from two case study properties in the southern brigalow bioregion. The results demonstrate that retaining trees in what would be otherwise fully-cleared paddocks provides positive benefits to the production system and aids the conservation of elements of the endemic biodiversity. However the project is at risk of overstating the biodiversity benefits of retaining native woody vegetation. Past extension activities could be seen as having made two incorrect assumptions. Firstly that the presence of certain biota is mistaken for persistence and secondly that beneficial ecosystem function translates to a positive biodiversity outcome. We will propose an approach to plotting the biodiversity trajectory of tree strips within grazing landscapes.

**MacHunter, Josephine and Wendy Wright**



josephine.machunter@sci.monash.edu.au School of Applied Science, Monash University, Gippsland Campus, Churchill, Vic. 3842

### **Differences in bird assemblages in forest fragments of two Ecological Vegetation Communities in Gippsland, Victoria**

The value of remnants for the long term conservation of bird species is widely recognized. However, little is known about the response of bird assemblages to fragmentation in different vegetation types. In this project, bird assemblages are characterised in fragments of two Ecological Vegetation Community (EVC) types (Damp Forest and Lowland Forest) in the Gippsland region, Victoria. Both these forest types are significantly depleted in the region, with Damp Forest covering less than 10% of its former range and Lowland Forest covering less than 30% of its former extent. Fragments will be characterized according to Ecological Vegetation Community type; size; habitat quality and landscape context, and the effect of these variables on bird assemblages will be investigated. This information is believed to be of value to landscape planners in the development of regional priorities for vegetation protection and restoration in combination with bird conservation in the extensively fragmented forests of the Gippsland region.

McKenna, David



djm02@uow.edu.au Biological Sciences, University of Wollongong, Wollongong, NSW 2522

### **Addressing the Seeds of Uncertainty: The Demographic Role of the Soil-Stored Seed Bank in Genus *Persoonia***

Assessment of the viability of threatened plant populations is becoming increasingly necessary under the requirements both State and Federal legislation. With an emphasis on management in the short term, the use of life-history data in a modelling framework is becoming a more prominent approach for viability assessment. Certain plant life-history traits such as long-lived soil-stored seed banks can however prove difficult to quantify. This study looked at life history characteristics associated with the soil-stored seed bank of a range of both common and rare fire sensitive *Persoonia* shrub species. A seed burial experiment was conducted over a 2-year period in order to estimate and compare the vital rates of the soil seed banks of the different species. Initial viability of the seeds ranged between 71 % and 100 % with seed decay over the two years being low in the unburnt sites. Some sites however, were burnt by wildfires with an associated increase in variability between replicates and an increased level of seed decay post-fire. Simulation models were used to examine the role of the seed bank in population viability given the levels of uncertainty in measurements of this life history stage.

**MacKinnon, Leah<sup>1</sup>, David Goldney<sup>2</sup>, Johannes Bauer<sup>2</sup> and Geoff Gurr<sup>2</sup>**



elmservices@bigpond.com 1. PO Box 814, Narrabri, NSW, 2390. 2. Faculty of Rural Management, University of Sydney, PO Box 883, Orange, NSW, 2800

### **Insectivorous bats, irrigated cotton, native vegetation remnants and intensive production landscapes**

Managing pest species and native vegetation remnants are two major environmental issues often confronting the producers of irrigated cotton. We are seeking to examine the hypothesis that insectivorous bats are beneficial predators of insect pest species in irrigated cotton production systems. In this project we are examining the links between insectivorous bats' foraging activities, their roosting requirements and their reliance on nearby native vegetation remnants for critical resources. Field research will be conducted seasonally during 2003/4 over a study area of approximately 90km<sup>2</sup> encompassing three properties and seven major vegetation and/or management units adjacent to the Namoi River near Narrabri, in northwestern NSW. We present the results of our preliminary findings of bat activity in this landscape from autumn 2003, together with the results of an assessment of the availability of tree hollows as potential bat roosting sites. The implications of our findings to date will be briefly discussed together with an assessment of the feasibility of incorporating bat fauna into existing Integrated Pest Management protocols.

**MacLeod, Neil and John McIvor**



neil.macleod@csiro.au CSIRO Sustainable Ecosystems, Level 3, QBP Building, 306 Carmody Rd, St Lucia, Qld 4068

### **The challenge of integrating conservation and economic production objectives on private grazing lands – Insights from the grassy woodlands of southern Queensland.**

The need to preserve biodiversity on privately managed agricultural landscapes is acute; particularly given the impracticality of achieving community conservation goals within formal conservation reserves. Landscape design principles for grazed woodlands have been developed to meet this goal under a recent project within the Native Vegetation R&D Program, which is managed by Land & Water Australia. However, major barriers of an economic and management nature were also identified that would constrain the adoption of these principles within contemporary management systems and arrangements for allocating shares of benefits and costs between private landholders and the wider community. The paper explores issues associated with balancing ecological and economic objectives in the context of grazing enterprises in southern Queensland's grassy woodlands. Problems encountered in promoting the principles to private land managers are discussed, as well as some insights from a second project that is seeking to further test the principles and improve their effectiveness under field conditions. Consideration is given to the prospects of collective action by groups of landholders that target key sites in a regional setting (e.g. neighbourhood catchment scale) to overcome prospective disadvantages that face individuals acting alone to implement conservation strategies consistent with the design principles on their holdings.

## McMullan-Fisher, Sapphire



smcmulla@postoffice.utas.edu.au School of Geography and Environmental Studies, University of Tasmania, Private Bag 78, Hobart 7001

### **Preliminary comparisons of four Tasmanian vegetation types using vascular plant, bryophyte and macrofungal data**

Four vegetation types were investigated, including wet forest, alpine heath, coastal heath and grassy woodlands near Hobart, Tasmania. Sites from these vegetation types were surveyed for vascular plants, bryophytes and macrofungi from 1999 to 2003. Preliminary presence/absence analysis suggests that many bryophyte and macrofungal taxa show congruence with vascular plant communities. Macrofungal and bryophyte presence shows clear links to substrate presence within communities. These taxa are connected to the ecosystem through the presence of favoured substrates.

## MacRaid, Lindy, Andrew Bennett and Jim Radford



macraid@deakin.edu.au Deakin University, School of Ecology and Environment, 221 Burwood Hwy, Burwood, Vic 3125

### **Mistletoes in rural environments: does landscape structure influence distribution?**

There is much interest in the relationship between landscape structure and the distribution of plant and animal species. Ecological processes that involve complex relationships between species are also likely to be influenced by landscape structure, but have received little attention. This project examines the relationship between mistletoe parasitism and the extent and pattern of tree cover in rural landscapes. Because they rely on bird vectors (which are affected by landscape structure) for dispersal, mistletoe distribution and abundance may also be influenced by landscape structure. Site assessments were conducted in 24 "sample" landscapes (100 km<sup>2</sup>) in northern Victoria that ranged from 2% to 60% tree cover. The numbers and species of trees parasitised by mistletoes (*Amyema* spp.) were recorded at 0.8 ha sites (roadsides, remnants and scattered trees) dominated by Grey Box *Eucalyptus microcarpa*. Mistletoes were patchily distributed, being recorded at 34 of 191 sites (18%), in 14 of the 24 landscapes. A greater density of trees with mistletoe was recorded in remnants than roadsides or scattered stands. Mistletoe occurrence at sites was modelled in relation to vegetation floristics and structure, land use, site isolation and landscape structure, to determine the relative influence of these factors on distribution patterns.

## Mackey, Brendan



Brendan.Mackey@anu.edu.au School of Resources, Environment and Society, Faculty of Science, The Australian National University, Canberra ACT 0200.

### **WildCountry – an overview**

At the most general level, the key question is how a conservation system can be designed for Australia that is likely to maintain biodiversity in the long-term (centuries to millennia). The WildCountry project (a collaboration between scientists, the Wilderness Society, governments and a diversity of private stakeholders) compliments existing initiatives, inter alia, by focussing on critical questions that have not been substantially factored into biodiversity conservation evaluation and planning in Australia. The project comprises three interrelated foci: (1) addressing knowledge gaps about large scale ecological processes critical to long term biodiversity conservation together with the landscape linkages needed to maintain their integrity; (2) developing and testing a new computer based conservation assessment and planning tool that incorporates information about these ecological processes; and (3) investigating how the planning tool and information base can be used by the stakeholders, facilitating their participation in conservation assessment and planning.



## **Linking Past and Future Vegetation Change Through Remote Sensing and GIS: An Approach to Cumulative Impact Assessment**

Cumulative impacts defined as the incremental impact of the actions in past, present, and reasonably foreseeable future, have changed and continue to change the vegetation cover all around the world. Attempts to mitigate those effects are generally suffering from the shortage of logistic resources on one hand and lack of understanding of the trajectory of those changes in the future on the other. These difficulties normally result in mitigation practices being focused on a selection of prioritized vegetation patches with the prioritization process and criteria being somewhat shortsighted.

In order to circumvent the above problems, change in remnant vegetation in the past 27 years was simulated and used as a basis for predicting the possible change in the next 27 years using Landsat MSS of the year 1973 and TM of the year 2000. The area of study is the catchment of the Boorowa River in New South Wales, Australia, around 110 kms northeast of Canberra.

After classifying the TM 2000 with field data and subsequent classification of the MSS 73, the actual change in vegetation patches was used to model the change using Neural Networks and Logistic Regression methods. Both decrease and increase in vegetation were considered and the results of the modelling were assessed through a combination of visual evaluation, ROC (Relative Operating Characteristics), and a modified version of the Multi-Resolution Goodness of Fit. 19 variables in three groups of bio-physical factors, image-based parameters and landscape metrics were used in the modeling. Assuming the future changes as following two scenarios and using the TM 2000 as the basis, the likely increase and decrease in vegetation in the next 27 years were also modelled. Both methods proved successful in modeling the past change in vegetation with the neural network being slightly better and more sensitive to the inclusion and exclusion of the variables.

Linking the past change along with the predicted change in the future provided a basis for cumulative impact assessment of vegetation on a landscape scale. These results when accompanied by the analysis of the likely change in patch metrics and patch internal structure through remote sensing, should provide a rigorous way of predicting and preventing the impacts through effective prioritization of the patches for mitigation measures.

## **Major, Richard, Greg Gowing, Fiona J. Christie, Mike Gray and Don Colgan**



richardm@austmus.gov.au Centre for Biodiversity and Conservation Research, Australian Museum, 6 College St, Sydney, NSW 2010

## **Variation in wolf spider abundance in relation to the size and shape of woodland remnants**

The response of animals to fragmentation of woodland habitat is variable. Small birds, particularly ground-feeding insectivores, have experienced considerable declines, whereas foliage-feeding insects appear to thrive in the edge-dominated habitats resulting from fragmentation. This study examines the response of a group of ground-feeding invertebrate insectivores: spiders of the family Lycosidae. We measured the abundance of fifteen species of wolf spider occurring in *Callitris* forests of the NSW wheat belt in remnants of five types: narrow linear strips, wide linear strips, small isolated remnants, the interior and edge of large forests, as well as the paddock matrix. There was no significant difference in the wolf spider community inhabiting the different types of woodland remnant, but this community was consistently different from that found in the paddocks. Variation in microhabitat, explained much of the variation in spider distribution, both between individual woodland remnants and between woodland remnants and paddocks. The most important variables were grass cover and the presence of logs. These results indicate that even small patches of woodland can provide valuable habitat for these important terrestrial insectivores as long as key habitat features are retained.

**Mansfield, Sarah**



sarah.mansfield@csiro.au CSIRO Entomology, Locked Bag 59, Narrabri NSW 2390

### **Detection of predation on *Helicoverpa armigera* in Australian cotton crops using ELISA**

Australian cotton crops have a significant community of native insect predators with potential to control the lepidopteran pest *Helicoverpa armigera* (Noctuidae). In the absence of broad-spectrum insecticides predator abundance increases over the growing season. The widespread development of insecticide resistance has led to increased interest in conservation biological control. To facilitate the adoption of such biological control by growers the key predators of *H. armigera* must be identified and their impact on pest populations measured.

Predation is difficult to observe and quantify under natural conditions because few traces are left of the prey after consumption. The detection of specific protein markers in predator gut contents allows direct measurement of predation from field-collected individuals. Here, I outline the development of ELISA protocols to detect predation by a predatory beetle, *Dicranolaius bellulus* (Melyridae), and a predatory bug, *Geocoris lubra* (Lygaeidae), on *H. armigera* using a species-specific monoclonal antibody. Although prey-specific proteins were detectable for only short periods within the predators, positive examples of predation have been recorded. Predators were collected from commercial cotton farms in northern NSW during the 2001-02 and 2002-03 seasons and predation of *H. armigera* quantified for both species. This technique will be extended to other predator species in the future.

**Marsden, Sharon<sup>1</sup> and Melinda McNaught<sup>1,2</sup>**



sharon.marsden@dpi.qld.gov.au 1. Department of Primary Industries, Fire Ant Control Centre, 280 Grindler Rd Wacol, QLD 4076. 2. Ecosystem Management, University of New England, Armidale, NSW 2351

### **Competitive interactions of *Solenopsis invicta* with selected native ant species**

The red imported fire ant, *Solenopsis invicta* Buren, is an invasive ant species recently discovered in Brisbane, Australia. *S. invicta* is a highly competitive invader that aggressively recruits to a resource and utilises defence behaviours that include chemical warfare. Many native ant species are likely to be displaced by *S. invicta* in Brisbane. The invasion success of this species in America has been well documented although much has focused on characteristics of colonisation and reproduction. The influence that the competitive ability of *S. invicta* has on its rate of spread subsequent to colonisation has not been as well documented and never explored in Australia. The competitive interactions with *S. invicta* and two native species common to urban Brisbane, *Rhytidoponera metallica* (Smith) and *Iridomyrmex nr. 'rufoniger'* (Lowne) were examined in a laboratory environment. One on one interactions were observed by examining the strategies employed by *S. invicta* individuals when in direct combat with individuals from native ant species through the use of aggression assays. Interspecific competition was observed by examining the exploitative and interference behaviours of each native species when in direct competition with *S. invicta* for a food resource. The role of competition in invasion processes and the impact local native ant species was explored to assess unsuspected or unique methods of control of *S. invicta*; and to understand better the behavioural mechanisms underlying competitive displacement between *S. invicta* and ants native to Australia.

**Marsh, Karen<sup>1</sup>, William Foley<sup>1</sup>, Stuart McLean<sup>2</sup> and Ian Wallis<sup>1</sup>**



karen.marsh@anu.edu.au 1. School of Botany and Zoology, Australian National University, Canberra, ACT 0200. 2. School of Pharmacy, University of Tasmania, Hobart, Tas 7001

### **Detoxification constraints as a limit to feeding**

In 1974 Freeland and Janzen proposed that saturation of individual detoxification pathways by plant secondary metabolites forced mammalian herbivores to consume a variety of food types. This would allow the detoxification load to be spread across several detoxification pathways, increasing the total amount of food that could be eaten. Despite being widely cited, there has been little direct evidence for this theory. Common brushtail possums are typically classed as generalist herbivores, eating *Eucalyptus* foliage as well as a variety of other foods. It is now well known that several eucalypt secondary metabolites can limit feeding by brushtail possums. Additionally, there have been detailed studies into the detoxification mechanisms employed by these animals. This has allowed us in the current study to investigate whether feeding limitations and diet mixing by brushtail possums are a response to physiological signals indicating detoxification capacity.

**Martin, Jennifer, Kathrine Handasyde and Graeme Coulson**



j.martin@zoology.unimelb.edu.au Department of Zoology, University of Melbourne, Vic, 3010

### **The influence of resource availability on the social and mating systems of bobucks (*Trichosurus caninus*).**

Resource availability can have strong intra-specific effects on social and mating systems in many species. Here we report the influence of food and shelter resources on the social and mating system of populations of bobucks (*Trichosurus caninus*), living in an intact forest block ('forest bobucks') and a linear roadside remnant ('roadside bobucks') in north-eastern Victoria. The sites have similar vegetation, but both silver wattle (*Acacia dealbata*), bobucks' main food resource, and hollow-bearing trees, providing den-sites, are at a greater density at the roadside site. Radio-collared bobucks use multiple den-trees, but forest bobucks (n= 32) use significantly fewer (mean + SE: 6.6 + 0.6 den-trees/individual) than roadside bobucks (n=18, 11.8 + 0.8). Forest bobucks are strongly paired, with pair members sharing the same den-trees and having home ranges of approximately equal size that overlap substantially. In contrast, roadside bobucks rarely share den-trees and each male's home range overlaps the home ranges of two or three females. Male forest bobucks generally sire only their partner's young, but roadside males may sire the young of several females. We propose that the variation in availability of key resources within forest and roadside sites affects the home range and mating system of bobucks.

**Martin, Tara<sup>1</sup>, Petra Kuhnert<sup>1</sup>, Hugh Possingham<sup>1</sup> and Kerrie Mengersen<sup>2</sup>**



Tara.Martin@csiro.au 1. The Ecology Centre, University of Queensland, St. Lucia, Qld 4072. 2. School of Mathematical and Physical sciences, The University of Newcastle, Callaghan NSW 2308

### **Do Experts Know Anything About Birds and Grazing? A Bayesian Approach Using Expert Opinion**

One of our greatest challenges as researchers is predicting impacts of landuse on biota. Predicting the impact of commercial grazing on birds is no exception given that grazing is often confounded with other disturbances resulting in few publications on the impact of grazing alone. However, there are professionals with extensive experience in bird observation across grazed landscapes. Using a survey of twenty well-recognised ornithologists and ecologists throughout Australia we capture this expert knowledge and incorporate it into a statistical model using Bayesian methods. Although relatively new to ecology, Bayesian methods allow straightforward probability statements to be made about specific models or scenarios and they allow the integration of different types of information from many sources, including scientific judgement. Data on bird density was collected across three broad levels of grazing (no/low, moderate and high) representing utilisation levels commonly found across southeastern Queensland. This field data was used in conjunction with the expert data to produce new estimates of species persistence under grazing. The addition of expert data through priors in our model strengthened results for 27 of the 31 bird species examined and highlighted that for most species, expert opinion is in accordance with our field results.

**Maves, Phillip and Graham Thompson**



Centre For Ecosystem Management, Edith Cowan University, 100 Joondalup Drive, Joondalup, WA 6027

### **A day in the life of a tropical aquatic monitor lizard**

The semi-aquatic tropical Varanid, *V. mertensi* (Mertens' Water Monitor), inhabits waterways across the wet-dry tropics of northern Australia. This near top of the food chain predator is a wide-ranging opportunistic forager that consumes both small invertebrates and the occasional large vertebrate, from both the terrestrial and aquatic environments. We present data gathered between January 2001 and January 2003 on a "day in the life" of a *V. mertensi* inhabiting the riparian/riverine ecosystems of the Ord River Irrigation Area in the East Kimberley of Western Australia. To do this we examine daily activity and foraging areas, thermoregulatory strategies, foraging behaviour, diet and burrow use. We have detected significant shifts in the behaviour of *V. mertensi* that are linked with seasonal variation in environmental conditions such as rainfall and ambient temperature. We also explain how *V. mertensi* responds to the Irrigation Authority's management of water throughout the irrigation scheme for agricultural purposes. We contrast the behavioural attributes of *V. mertensi* with those of other large terrestrial goannas, and explain how the use of the aquatic environment by this species affects its activity areas, foraging behaviour, temperature regulation and inactive period.

**Metcalfe, Lisa and Murray Ellis**



lisa.metcalfe@npws.nsw.gov.au New South Wales National Parks and Wildlife Service, Hurstville, 2220

**Remnant native woody vegetation in agricultural landscapes: past clearing, current trends and future directions.**

Based on the mapped extent of remnant native woody vegetation, from three time periods, clearing simulations have been generated for past and future landscapes. The patterns resulting from these simulations have been tested against the current distribution of remnant native woody vegetation. The on-going decline in vegetation cover in the sheep-wheatbelt is highlighted and the ecological implications of this decline is explored further by comparing two survey datasets and examining changes in structural diversity and species richness over time.

**Mitchell, Chris**



chris.mitchell@greenhouse.crc.org.au CRC for Greenhouse Accounting, GPO Box 475, Canberra, ACT 2601

**Carbon Accounting: Beyond the Current Kyoto Paradigm**

The Kyoto Protocol is an instrument within the framework of the United Nations Framework Convention on Climate Change intended to enable the global community to start the process of defined greenhouse gas emission reductions. The Protocol was negotiated in 1997, but it was not until the Marrakesh Accords were agreed in 2001 that the details of how the Protocol would be implemented were known. From an ecological viewpoint interest in the Protocol and the Marrakesh Accords exists because they attempt to explicitly define the role of carbon stored in the biosphere within greenhouse abatement strategies. The policy construct represented by the Kyoto-Marrakesh system was developed in a fluid environment in which scientific uncertainty played a major role. This paper will review these developments and identify key issues that are likely to feature in future discussion.

**Molsher, Robyn and Peckham, Peter**



robyn.molsher@npws.nsw.gov.au NSW National Parks and Wildlife Service, PO Box 2111, Dubbo, NSW 2830

**Making Aboriginal views count in water management planning in central western NSW**

Consideration of Aboriginal issues in wetland management policies and planning is currently absent or comprises single sentences that are ineffective in representing Aboriginal views in NSW. This project will investigate ways in which Aboriginal views can be increased in water management planning and policies. Methodologies will be trialed for the Peak Hill Local Aboriginal Land Council area in central western NSW. A wetland on the Bogan River will be culturally mapped to identify issues of significance and Aboriginal communities will be consulted for guidance in the most appropriate ways to involve communities in the water management planning process. This project seeks to identify ways in which the capacity of Aboriginal people to be involved in and contribute to wetland and river management processes can be improved.

**Montagu, Kelvin<sup>1</sup>, Annette Cowie<sup>1</sup>, Andrew Raison<sup>2</sup>, Brian Wilson<sup>3</sup> and Brendan George<sup>4</sup>**



kelvinm@sf.nsw.gov.au 1. State Forests of NSW, Research & Development Division, PO Box 100, Beecroft, NSW 2119. 2. Department of Infrastructure, Planning and Natural Resources, c/o University of Sydney, PO Box 883, Orange, NSW 2800.

3. Department of Infrastructure, Planning and Natural Resources, PO Box U245, University of Armidale, NSW 2351. 4. NSW Agriculture, RMB 944, Tamworth, NSW 2340.

**Carbon sequestration predictor for revegetation schemes in lower rainfall areas of NSW**

Revegetation of cleared agricultural lands is being encouraged as a key measure to combat expansion of dryland salinity in the 400-800mm rainfall region of NSW. Proposed land use changes include replacement of annual herbaceous species (crops, pasture) with woody perennial species. Besides salinity mitigation benefits, revegetating cleared land with woody perennials will provide additional environmental benefits, including carbon sequestration. The current rapid rise in atmospheric carbon dioxide levels may result in much of Australia becoming hotter and drier due to the enhanced greenhouse effect. Reforestation slows the build-up of carbon dioxide, the principal greenhouse gas.

The Carbon Sequestration Predictor aims to inform landholders, policymakers and the public about the potential for carbon to be sequestered by land use changes in the lower rainfall areas of NSW, a region not well catered for by traditional forestry models. The Carbon Sequestration Predictor (Version 2.0) predicts the likely changes in both biomass and soil carbon associated with a number of land use changes.

The Carbon Sequestration Predictor has been used by the NSW Environmental Services Scheme (ESS) and incorporated into the Strategic Landscape Investment Model, to inform resource allocation so that funding to support land use change is directed to maximise environmental benefit. This talk provides the context, guide to its use and detail of the Carbon Sequestration Predictor.

**Moran, Cath, Carla Catterall, Ronda Green and Mike Olsen**



c.moran@griffith.edu.au Faculty of Environmental Sciences, Griffith University, Nathan, QLD 4111

### **Changes in a frugivorous bird assemblage and rainforest seed dispersal in a fragmented landscape.**

Frugivorous birds disperse the seeds of a large proportion of rainforest plants, hence differences in frugivorous bird abundance between fragmented and forested parts of the landscape may affect seed dispersal and rainforest regeneration dynamics. We investigated frugivorous bird use of rainforest habitats in a fragmented subtropical landscape in south-east Queensland. Frugivorous bird abundance was surveyed in three site types – extensive forest, remnant and regrowth patches. Individual bird species varied in abundance between the three site types. A suite of species showed decreasing patterns of abundance in remnants and regrowth patches, while others exhibited increasing abundance in these sites. Birds in the ‘decreaser’ group may disperse seeds from a different set of plant species to those in the ‘increaser’ group. We examine how differences between bird species in their dietary composition may have consequences for seed dispersal in rainforest remnants and regrowth patches, compared with extensive forest. Our results suggest that large-seeded plants are less likely to be dispersed in fragmented and disturbed parts of the study landscape than in large tracts of forest.

**Morgan, Huw and Mark Westoby**



hmorgan@bio.mq.edu.au Dept. Biological Sciences, Macquarie University, Sydney, NSW, 2109

### **Steeper rootedness is co-ordinated with drought resistant leaves, but does not differ between high or low rainfall**

We present results from an investigation of two ideas; (1) water-use strategy is co-ordinated at a whole-plant level, from roots to leaves and (2) long-lived, woody species at lower rainfall sites offset the decreased availability of water at the soil surface by being deeper-rooted and obtaining water from deeper soil layers. We excavated root systems of 63 species of woody, perennial shrubs from four sites; two at high rainfall and two at low rainfall. At each rainfall location, sites differed in soil texture. Roots were classed as either steep or shallow depending on their orientation to vertical. Species with a larger fraction of steep root cross-section also had leaves more resistant to drought (higher leaf mass per area; LMA), although an increase across species in the steep-root fraction led to a sharper increase in LMA at high rainfall, compared to low rainfall. Surprisingly, there was no difference between species from high or low rainfall in the amount of steep root compared to total root. Further, when compared on the basis of above-ground sapwood, species at high rainfall actually had larger root systems and more steep root at a given sapwood cross-section compared to species at low rainfall.

**Morgan, John**



J.Morgan@latrobe.edu.au Department of Botany, La Trobe University, Bundoora, Vic 3083

### **Do small plots adequately describe the effects of fire frequency on plant diversity in native grasslands?**

Native grasslands in western Victoria can be species-rich at small spatial scales (e.g. 0.25 m<sup>2</sup> to 100 m<sup>2</sup>) when burnt regularly. Competitive exclusion by dominant grasses is thought to be the key process affecting diversity and hence, frequent burning has been routinely suggested as necessary to maintain diversity. For >25 years, however, the effects of fire in grasslands have been largely studied by using only small quadrats. Do small-scale studies really provide evidence for disturbance-mediated coexistence in grasslands? At larger spatial scales (e.g. >1000 m<sup>2</sup>), local spatial habitat heterogeneity may be sufficient to maintain diversity in all but the most homogeneous patches and hence, burning may have little effect on species richness at landscape scales. Hence, using small quadrats may exaggerate the differences in diversity reported for frequently-burnt and unburnt areas. In Kangaroo Grass grasslands that differed in their long-term fire frequency (frequent, intermediate, low), I used nested quadrats (1m<sup>2</sup> to 1024 m<sup>2</sup>) to examine the relationship between spatial scale and native and exotic plant diversity. Specifically, I ask: does fire frequency predict species diversity at large spatial scales as it seems to do at small-scales? The results will be discussed in terms of conservation management of grasslands and disturbance theory.

Morley, Phil



pmorley@pobox.une.edu.au Institute for Rural Futures, UNE Armidale 2351

### **Incorporating Socio-economic concerns into marine reserve planning**

While land uses have long been regulated, people have always enjoyed the common property rights and inherent freedoms of the seas. The 'sudden' control of these marine environments brought about by marine reserve placement is often perceived to violate these long-standing rights and is hence causing numerous conflicts throughout the world. This study looks at how the support of stakeholders and local communities can be obtained to help ensure the success of marine protected areas by exploring the socio-economic impacts of marine reserve placement and assessing multiple criteria analysis as a tool for use within the planning process.

**Morris, E. Charles<sup>1</sup>, Paul Thomas<sup>1</sup> and Tony Auld<sup>2</sup>**



c.morris@uws.edu.au 1. Ecology Research Group, Science Precinct (K12), Hawkesbury Campus UWS, Locked Bag 1797, South Penrith DC 1797. 2. NSW NPWS, PO Box 1967, Hurstville NSW 2220

### **During the fire: combined effects of heat shock and smoke on germination.**

Much work on the germination response of seeds to fire-related cues has looked at these cues individually eg. heat shock response, smoke response. A smaller number of studies have looked at combinations of germination cues, an approach which allows identification of interactions between germination cues. This approach of combining germination cues (heat shock, smoke) was used to investigate the response of seeds of 23 species from three major Families of southeastern Australia. Heat shock temperatures spanning the range up to 1000C were combined with several durations of smoking, and the germination response observed. Four species showed an independent and additive response to both cues, and 3 species a response to smoke alone. A number of interactions between the cues were observed, ranging from a synergistic response to both cues (1 sp.), obligatory requirement for both cues (unitive response, 7 spp.), and a complex and previously undescribed interaction (3 spp.). For 4 species, multiple populations were tested, and in only one case was the germination response consistent across populations. This study highlights the importance of using multiple germination cues in germination studies, and some of the problems associated with interpretation of results.

**Morris, Fiona<sup>1</sup>, Charlie Zammit<sup>1</sup> and Steven Raine<sup>2</sup>**



morrisf@usq.edu.au 1. Land Use Research Centre, University of Southern Queensland, Toowoomba, QLD 4350. 2. National Centre for Engineering in Agriculture, University of Southern Queensland, Toowoomba, Qld 4350

### **Water-use characteristics of a Mountain Coolibah (*Eucalyptus orgadophila*) woodland in a salinity risk area of the Darling Downs, Queensland.**

Dryland salinity is a significant issue in Queensland, where the extent of affected areas and continuing agricultural development in salinity hazard regions is causing concern for future resource management. Without understanding the complex relationships between natural vegetation, soil and water movement in the context of Queensland's climate, few management decisions can be accurately made at the property level to prevent salinity outbreaks. To assess the importance of remnant woodland vegetation in salinity mitigation, this project examines the effect of a grazed *Eucalyptus orgadophila* (Mountain coolibah) woodland and adjacent pasture systems on soil characteristics and water movement. The project focuses on the soil profile to determine if or how vegetation affects soil-water movement and soil characteristics and whether these differences can be directly attributed to the proximity, density and species composition of surrounding trees/shrubs and grasses. Preliminary data has shown differences in water movement, bulk density, anions, cations and especially chloride content (indicator of water table fluctuations, and salt content) beneath pasture and all the woodland treatments. It is anticipated that the results will help explain the variability in water use beneath some common land uses in the Darling Downs region and their effect on soil characteristics. The importance of monitoring upslope water movement in salinity risk areas for effective salinity prevention is highlighted.

**Morton, Stephen**



Steve.Morton@csiro.au CSIRO Environment and Natural Resources, GPO Box 2697, Canberra ACT 2601

### **Science and policy : some hard lessons**

The linkage between science and public policy is among the most interesting of grey areas. Sometimes the link brings delight to participants from both sides; on other occasions it's a minefield. I will reflect on three recent

interactions which I have had the opportunity to observe at relatively close range - the Wentworth Group's activities with respect to natural resource management; bushfires; and population futures. In doing so, I will try to draw out lessons be they good or tough.

**Mott, Beth, Bill Buttemer and Kris French**



bm14@uow.edu.au Dept. of Biological Sciences, University of Wollongong, Northfields Ave., Wollongong, NSW 2522

### **Do preferences for thermal or structural environment dictate assemblage structure in lizards?**

Monoculture tree plantations are a rapidly proliferating forest type throughout Australia. Plantations have potential to represent a unique habitat within a landscape mosaic for both endo- and ectotherms, as both establishment and management create a highly simplistic vegetation structure, resulting in high levels of light and heat at ground level. The dramatic change in the thermal and structural environments between native forests and plantations has great potential to affect ectothermic animals. Lizards are a diverse group of ectotherms whose potential to respond to large environmental changes is mediated by both physiology and behavioural plasticity. This study attempts to understand what aspects of the environment may be responsible for observed differences in lizard assemblage structure in plantations and native forests. Results of a set of three lab- and field-based experiments suggest that some lizard species are restricted to a habitat by thermal preferences driven by inflexible physiology, whilst others exhibit strong preferences for complex environmental structure. As plantation environments change with age, we can predict for the five lizard species examined that only one species is likely to move into plantations, whilst one species occurring only in plantations may have the potential to move into other habitat types.

**Munroe, Evan and Ian Williamson**



e.munroe@student.qut.edu.au School of Natural Resource Sciences, Queensland University of Technology, GPO Box 2434, Brisbane QLD 4001

### **The influence of vegetation on the distribution and abundance of ghost crabs.**

Ghost crabs (*Ocypode* spp.) form a significant component of the invertebrate biomass of exposed sandy beaches in tropical and sub-tropical regions of the world. Studies of other species in the family Ocypodidae have demonstrated that components of vegetation structure have a significant effect on distribution, but there are few studies of the effects of vegetation on the density and distribution of ghost crabs in Australia. This study examined the abundance of ghost crab burrows in relation to vegetation on coastal dunes in south east Queensland. Observational studies showed a significant positive relationship between vegetation cover and crab burrow density so a series of manipulated plots that varied the amount of above-ground and below-ground structure were set up on previously bare areas. Significantly more new burrows were constructed in plots where shade was present. At sites where above or below structure was present without shade, a recorded density half that of shaded structures occurred. Predator avoidance and /or temperature amelioration were the most likely reasons for site selection. The possibility that vegetation may increase foraging options seems less plausible as ghost crabs forage over large areas. Also, the suggestion that root systems are important because they provide support for burrow construction was not supported by this study.

**Murray, Brad R.<sup>1</sup> and Brown, A.H.D.<sup>2</sup>**



Brad.Murray@uts.edu.au 1. Institute for Water and Environmental Resource Management, University of Technology, Sydney, Gore Hill., NSW 2065. 2. Centre for Plant Biodiversity Research, CSIRO Plant Industry, Canberra

### **Geographical gradients in seed mass and the influence of climate**

Variation in seed mass among and within *Glycine* species was investigated in relation to latitude and longitude. Seed mass was estimated from over 1600 provenances covering the latitudinal and longitudinal extents of 34 perennial *Glycine* taxa in Australia. Significant latitudinal and longitudinal gradients in seed mass were observed among species, with larger seed mass found towards the tropics and in the interior of the continent. Similar patterns were found consistently within species. Increases in seed mass were found to be related to increases in temperature and solar radiation, while rainfall was much less influential upon seed mass. Explanations for these patterns are discussed.

**Nelson, Jennie, Meredith Brainwood and Shelley Burgin**



j.nelson@uws.edu.au University Western Sydney, Richmond Campus, Locked Bag 1797, Penrith South DC NSW 1797

### **Bio-indicators and Biodiversity: Future directions in aquatic environments**

The need for biological indicators to supplement physico-chemical sampling of water quality has become obvious in recent years. Here in Australia, the outright acceptance, and therefore, the limited use of bio-indicators, has been hampered by a lack of 'local' knowledge as applied to the Australian species. This shortfall in knowledge, both taxonomic and ecological, needs to be addressed to determine whether Australia truly possesses an 'endemic' or a more 'cosmopolitan' biodiversity when compared to the Northern Hemisphere. This work examines two recent projects utilising bio-indicators for very different purposes in aquatic research. The first uses microscopic algae as potential indicators of cultural eutrophication in an urban environment in Sydney whilst the second examines the use of bird and macroinvertebrate diversity to measure the efficacy of farm water management strategy.

**Nichols, Peter**



cpr@ihug.com.au 173 Somerville Rd, Hornsby Heights, NSW 2077

### **Restoration of Temperate Woodlands- Getting it right in CPW.**

The main objective of this project is to evaluate the extent to which restored vegetation provides sustainable habitat for native flora. The initial sampling design involved a comparative analysis of vegetation (structure and composition) between endangered remnant woodland vegetation (restoration goal), revegetated agricultural land (chronosequence) and pasture sites (restoration starting point). Results indicate that the species composition of the three vegetation communities remains distinct from each other with a direct path of restoration trajectory yet to be revealed. Pasture sites have the lowest native species diversity, revegetated sites represent a 10% and remnant vegetation another 30% increase in the proportion of natives present. Comparison of the population structure between the vegetation types has revealed similarities except for mature individual trees being absent from revegetated sites. The aim of the second part of this experiment is to evaluate the differences in germination, establishment and recruitment of native vegetation in pasture, revegetated and remnant areas using fire and slash/herbicide treatments. From the results analysed thus far, it may be argued that revegetation of agricultural land in a woodland community may take many years to achieve any noteworthy degree of success.

**Nicotra, Adrienne<sup>1</sup>, Meredith Cosgrove<sup>1</sup>, Carl Schlichting<sup>2</sup> and Cindi Jones<sup>2</sup>**



adrienne.nicotra@anu.edu.au 1. School of Botany and Zoology, Australian National University, Canberra, ACT 0200. 2. Dept. of Ecology and Evolutionary Biology, University of Connecticut, CT USA

### **Does the effect of leaf shape on leaf temperature influence carbon gain and water use?**

There is a tremendous range of variation in leaf shape among plants and we are only beginning to understand its functional significance. A divided or dissected leaf should track ambient temperatures more closely than an entire leaf of the same area. On hot days, the entire leaf will rise well above air temperature. Because photosynthesis is optimum at a certain temperature, differences in leaf temperature affect carbon gain. Transpiration increases with increasing temperature so that at the leaf level, water use efficiency declines once temperature exceeds the optimum for carbon gain. We measured the thermal response of photosynthesis in *Pelargonium* plants grown at two temperature and water levels. We asked whether leaves from species with different shapes, when grown on plants at different water and temperature levels, varied in their characteristic rates of heating and cooling. By mapping the thermal response of photosynthesis on to the thermal profile of leaves, we were able to assess the affect of leaf shape and growth conditions on carbon gain and water loss.

**Nielsen, Daryl<sup>1</sup> and Margaret Brock<sup>2</sup>**



daryl.nielsen@csiro.au 1. Murray-Darling Freshwater Research Centre, PO Box 921, Albury, NSW, 2640. 2. Department of Infrastructure, Planning & Natural Resources, PO Box U245, Armidale, NSW, 2351

### **Current research and future directions for aquatic salinity: What are the crucial questions?**

We know that a range of aquatic ecosystems across Australia are saline. Some are naturally saline, others have become saline, and the predictions are that many more will become saline over time. The natural variability in the ranges of salinity may also have changed through anthropogenic activities. The hydrology of aquatic ecosystems may relate to how salinity affects wetland function. We also know that increase in salinity may be

expressed differently in different types of aquatic ecosystems. Increasing salinity reduces the species richness of a range of biological groups and may also influence life cycle parameters such as germination, hatching and recruitment. This paper explores what we know of the structure and function of aquatic ecosystems along a gradient of salinity. More importantly it explores what we don't know about the ecology of salinity and what we need to know to help manage salinity. If we understand the change to ecological structure and function as an aquatic systems change from fresh to saline we will begin to understand the ecology of this process of degradation. This understanding should also lead us to explore how ecology changes as a system changes from saline to fresh during the process of rehabilitation.

**Nipperess, David and Andrew Beattie**



dnippere@ma.bio.mq.edu.au Department of Biological Sciences, Macquarie University, NSW, 2109

### **Morphological dispersion of spatially nested assemblages of *Rhytidoponera* (Formicidae: Hymenoptera), Sturt National Park, Australia**

A series of spatially nested assemblages of *Rhytidoponera* OTUs (Formicidae: Hymenoptera) from Sturt National Park, New South Wales, Australia, were examined for patterns of dispersion in multivariate morphological space. Morphological overdispersion within an assemblage, relative to a null model, is considered to be a result of the structuring influence of interspecific competition. We compared up to 45 observed assemblages, from across multiple spatial scales, to two null models. Meta-analysis of the null model analyses indicated a general trend to morphological overdispersion, particularly so at restricted scales. Larger scale assemblages were overdispersed relative to only one of the two null models, which we tentatively interpret as being indicative of different competition-driven mechanisms operating at different spatial scales. We also demonstrate that the observed assemblages represent a larger number of species-groups than expected by chance, and that this pattern of phylogenetic overdispersion is closely related to the observed morphological patterns.

**Norton, Tony and Simon Jones**



tony.norton@rmit.edu.au Department of Geospatial Science, GPO Box 2476V, Melbourne, Victoria 3000

### **Geospatial technologies for managing agricultural landscapes**

Advances in geospatial technologies such as GIS, remote sensing and GPS coupled with new systems modelling and visualisation techniques provide unprecedented opportunities to enhance the management of agricultural landscapes. Technical advances include a significant increase in the integration and interoperability of data capture, mapping, modelling and visualisation systems, and further development of telecommunications infrastructure to deliver information more effectively and in near-real time to regions. New satellites now provide access to sub-metre imagery that is updated regularly. Applications of these technologies to enhance agricultural production have extended beyond "proof-of-concept" and are routinely employed commercially. Extensions of these approaches to whole farm and catchment scale management will be illustrated using examples from north central Victoria. These demonstrate that a diverse range of landscape values, including biodiversity, can be analysed using these technologies, helping to meet multiple management objectives in a cost-effective way.

**Oliver, Ian**



Ian.Oliver@dipnr.nsw.gov.au Department of Infrastructure, Planning and Natural Resources, PO Box U245, University of New England, Armidale, NSW 2351

### **Market-based mechanisms for improved biodiversity conservation on private land**

Several recent Australian natural resource management initiatives have taken a market-based approach to the allocation of incentive funding for land use change for environmental benefits. Market-based approaches help to ensure that scarce resources are allocated to those land-use changes that will deliver greater benefits. They also encourage land-owners to promote the biodiversity value of their land in the knowledge that positive land use change in high conservation value habitat will be favoured by these approaches.

This presentation will introduce market-based approaches that have focused on biodiversity, and discuss in more detail the components of one of these (the Biodiversity Benefits' Toolkit) that was recently developed for application to the NSW Environmental Services Scheme. This Toolkit, which is a product of collaboration between government departments, stakeholders and independent experts in NSW and Victoria, was designed to achieve three goals:

- Score the current biodiversity value of a site.

- Estimate the magnitude and direction of change in biodiversity value resulting from land use change.
- Incorporate these current and potential values into a Biodiversity Benefits' Index.

The talk will conclude with the presentation of empirical biodiversity data which have been specifically collected and analysed to test some of the assumptions contained within the Biodiversity Benefits' Toolkit.

**Ooi, Mark**



mark.ooi@npws.nsw.gov.au NSW National Parks & Wildlife Service, BRMD, Biodiversity Research Group, PO Box 1967, Hurstville NSW 2220

### **Fire response, fire patchiness and post-fire population persistence of *Leucopogon***

In fire-prone habitat, understanding how a species copes and persists with any particular fire regime requires the fundamental knowledge of the response to fire of individual plants. However, an area little studied but likely to have a significant impact on population persistence is patchiness of fire. The aims of this study were to confirm whether individuals of four *Leucopogon* species are fire sensitive, determine the effects of fire intensity on fire patchiness, and how this affects local populations of the study species. Results after several fires of differing intensities showed that all four study species are fire sensitive. Many individuals tagged survived as a result of fire patchiness, particularly after low-intensity fires. Consequently, although the species are categorised as obligate seeders, the survival of some individuals within the landscape can provide a level of population persistence. Threatened species, particularly obligate seeders with long juvenile periods, may persist in areas where at least some of the fire events are avoided. There are few studies investigating fire shadows or refugia, and the survival of flora. Quantitative studies of the importance of unburnt patches of habitat to flora communities, including rare species within them, would contribute greatly to our understanding of vegetation dynamics in fire prone systems.

**Owen, Kathleen J. and Glenda Vaughton**



kowen2@metz.une.edu.au Botany, University of New England, Armidale, NSW 2351

### **The mechanism of self-sterility in *Bulbine bulbosa*: self-incompatibility or inbreeding depression.**

Many flowering plants are self-sterile and produce few seeds following self-pollination compared with cross-pollination. Two mechanisms of self-sterility that have been proposed are physiological self-incompatibility (SI), a genetically controlled self-recognition system which reduces self-fertilisation, and early-acting inbreeding depression (ID) in which selfed embryos homozygous for deleterious recessive alleles abort during development. Distinguishing between SI and ID is a critical issue because inbreeding depression pre-empted ovules and reduces the likelihood of cross-fertilisation. Seed abortion appears to be a major factor contributing to low seed set following selfing in the lilioid monocot, *Bulbine bulbosa* (Asphodelaceae). We used histological techniques to determine whether self-sterility is due to SI or ID. Ovules were examined at various times after flowers were pollinated with either self or cross pollen. Preliminary results reveal high levels of fertilisation following both self- and cross-pollination, indicating that the self-sterility mechanism is primarily post-zygotic. In addition, observations of selfed vs. crossed ovules 7 days after pollination provide evidence of abortion following selfing. These results are consistent with early-acting inbreeding depression being the major mechanism of self-sterility in *B. bulbosa*.

**Parr Jeff<sup>1</sup>, Kathryn Taffs<sup>2</sup>, Geoff Kerr<sup>2</sup> and John Athur<sup>2</sup>**



jparr@scu.edu.au 1. Laboratory Manager, Centre for Geoarchaeology and Palaeoenvironmental Research, School of Environmental Science and Management, Southern Cross University, PO Box 157 Lismore, NSW 2470. 2. School of Environmental Science and Management, Southern Cross University, PO Box 157 Lismore, NSW 2470.

### **Fires and their implications for acidic peatlands northeastern NSW.**

Peatlands are important ecosystems that provide niche habitats for an abundant range of flora and fauna. Significantly, peatlands also act as filtration systems for our waterways and assist in the reduction of atmospheric CO<sub>2</sub> by the sequestration of large amounts of organic carbon. Unfortunately our coastal wetland peat systems are fast becoming an endangered species due to practices such as landfill for housing development and the draining of large areas to reclaim land for agricultural purposes. Thus it is imperative that we manage the remaining coastal wetland systems in a sustainable manner. This necessarily requires a fundamental understanding of the evolutionary processes resulting in the formation of peatlands through microfossil studies and the nature processes causing their stability and/or fragility. Recent widespread drought has caused many of

these systems to become vulnerable to fire. Here we examine the nature of fire, its impact on acidic peatlands in northeastern NSW, the possible implications for microfossil interpretation and increased atmospheric CO<sup>2</sup>.

**Parry-Jones, Kerry and Glenda Wardle**

kpjones@bio.usyd.edu.au A08 Biological Sciences, University of Sydney, Sydney, NSW 2006



### **A Sink or a Source?: The Grey-headed Flying-fox, *Pteropus poliocephalus* at an Urban Colony Site**

The population of the Grey-headed Flying-fox, *Pteropus poliocephalus* is spatially structured into colonies, concentrations of flying-foxes at traditional sites throughout its distribution in the coastal regions of eastern Australia. An urban colony site of *P. poliocephalus* at Gordon Sydney, was monitored during spring and summer for ten years from 1990 to 2000 to determine the levels of mortality associated with urban living. A population model was developed and using the female and juvenile mortality estimated in this ten year study, an overall negative growth rate for the colony was determined ( $r = -0.0290$ ). Despite the declining population, the size of the October colony appears to be similar across the years (approximately 32,000 animals). This indicates that immigration from other breeding colony sites may be responsible for the local persistence of this colony and the Gordon colony can be regarded as a population "sink" rather than a "source". As *P. poliocephalus* is a vulnerable species, the use of a colony site that does not support a self-sustaining population of this species has important management implications.

**Peacock, Ross J. and Neil J. Davidson**

Ross.Peacock@utas.edu.au School of Plant Science and CRC for Sustainable Production Forestry, University of Tasmania, Private Bag 55, Hobart Tasmania 7001



### **Thresholds of resilience: The Soft Tree-fern (*Dicksonia antarctica* Labill.) in a forest production landscape in Tasmania.**

*Dicksonia antarctica* is a conspicuous and long-lived understorey species of the cool wet forests of south eastern Australia which is damaged by intensive forest management. Its functional importance includes the provision of substrates for rainforest tree and shrub germination and as a support for obligate epiphytic flora. The results of a monitoring study using permanently tagged individuals indicated that while 80% of the *D. antarctica* individuals resprouted following physical damage associated with cable logging, only 40% survived the additional imposition of intensive burning, with survival reduced to 27% after 10 years. Resilience was related to individuals' size characteristics, position, degree of physical and fire disturbance and orientation. Particularly small (<30 years old) and large individuals in the population were disproportionately less resilient and those surviving did so with reduced vigour. No new recruitment occurred during the 10 year period. The results show that multiple disturbances associated with standard forest management practice are detrimental to both the long-term survival of the species as a conspicuous and functionally important component of the understorey environment and of its cargo of epiphytic ferns and bryophytes.